



Lochinvar®

High Efficiency Water Heaters And Boilers

The Built-In Advantage™

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Electric Hot Water and Steam Boilers

OPERATION AND MAINTENANCE MANUAL

→ **WARNING** ←

A complete understanding of this manual is required before attempting to operate or maintain the equipment. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage.

The equipment should be operated and maintained only by personnel who have read this manual and who have a working knowledge and understanding of the equipment.

NOTE

These instructions are intended as a guide for the Installing Contractor and as a reference for the Operator, Owner and Serviceman.

RETAIN THESE INSTRUCTIONS NEAR THE EQUIPMENT FOR READY REFERENCE

The instructions contained in this manual are intended as a guide only and do not supplant any National, State or Local Codes.

This unit must be installed in accordance with those installation regulations in force in the local area where the installation is to be made. These shall be carefully followed in all cases. Authorities having jurisdiction shall be consulted before installation is made.

LOCHINVAR has a commitment to product improvement and continually strives for the highest standards of product performance. In pursuing this policy of continuous development of products, the manufacturer reserves the right to vary any details in this manual without notice.

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Chapter 1

INTRODUCTION

1.A. GENERAL INFORMATION

This **LOCHINVAR** Electric Hot Water and Steam Boiler Operation and Maintenance Manual presents information that will help to properly operate and care for the equipment. Study the contents carefully. The unit will provide good service and continued operation if proper operating and maintenance instructions are followed. The standard Limited Warranty does not apply to boilers not installed or operated in accordance with these procedures.

LOCHINVAR boilers are designed and engineered to provide excellent service and to give long life on the job. Although the unit and its components afford a high degree of protection and safety, operation of the equipment is not to be considered free from hazards inherent in the handling of electricity and pressurized hot water or steam.

Pay close attention to **WARNINGS** and **CAUTIONS** as these present situations of potential hazard, and remember no amount of written instruction can replace intelligent thinking and reasoning.

1.B. LOCAL REGULATIONS

Consult local building and safety codes before proceeding with work. The operation of this equipment by the owner and his operating personnel must comply with all requirements or regulations of the authorities having jurisdiction.

In the absence of such authorities, the installation must conform to the safety codes set forth by the American Society of Mechanical Engineers (ASME).

1.C. RECOMMENDATIONS

1.C.1. Preventive Maintenance

A Preventive Maintenance Schedule is provided as a recommendation for periodic boiler inspections. Recording of daily, weekly, monthly and yearly maintenance activities, as well as the recording of any unusual operation, will serve as a valuable guide to any necessary investigation.

The standard Limited Warranty does not cover any damage caused by lack of required maintenance.

1.C.2. WATER TREATMENT

Feedwater and Boiler Water Properties should be maintained in accordance with the table provided in this manual. It is customary to engage the services of a qualified water treatment consultant to recommend the proper water treatment program.

Damage from scaling, corrosion or erosion attributed to improper treatment of boiler water is not covered by the standard Limited Warranty.

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Chapter 2

STORAGE & HANDLING

2.A. RECEIVING

Each LOCHINVAR boiler is completely inspected at the factory and carefully packaged for shipment. Upon receipt of the shipment, immediately inspect the packing for signs of exterior damage. Verify receipt of all packages listed on the packing slip. Advise the carrier of any shortage or damage. Any such claims should be filed with the carrier. The carrier, not the shipper, is responsible for shortages and damage to the shipment.

2.B. STORAGE

Electrical equipment can be damaged if exposed to adverse weather. *The boiler should be stored inside.* The electrical panel and controls should be covered with plastic throughout all construction to avoid accumulation of dust and moisture on the controls and load components. The contactors can be damaged by dust/dirt in the mechanism.

2.C. UNCRATING

- 2.C.1. Care must be taken not to damage controls or deform the boiler sheet metal during removal of the crate.
- 2.C.2. If using pry bars or fork lifts, be certain to support the boiler weight by the skids or channel base.

2.D. PLACEMENT

! CAUTION !

If the boiler is to be placed in a room with little or no ventilation, a supply of ducted filtered air may have to be brought to the lower portion of the control cabinet to limit the control cabinet interior temperature to 50°C (122°F) maximum.

- 2.D.1. Provide a *firm, level* foundation for the boiler.

NOTE: Standard electric boilers are not suitable for placement on combustible flooring.

- 2.D.2. Leave a permanent space for element removal opposite element access panels as shown on the Dimensional Drawing (DD), and 36 inches opposite electrical panels.

NOTE: 42" is required opposite electrical panels if the opposing surface is conductive.

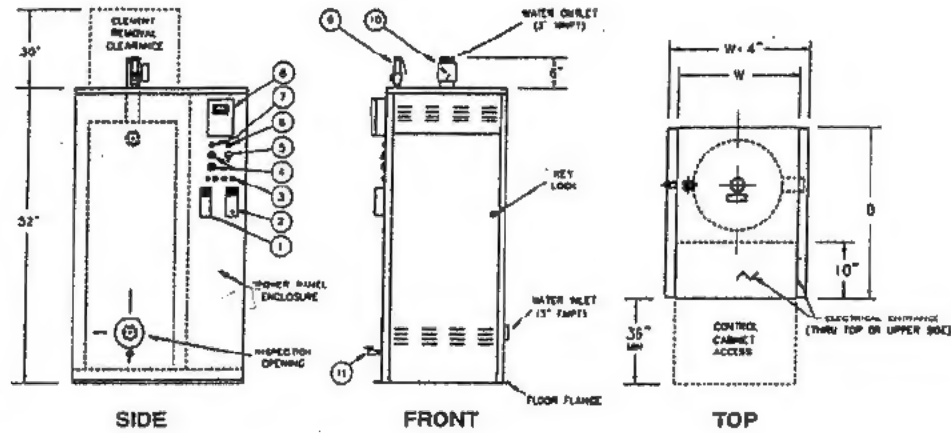
- 2.D.3. Be sure to keep electrical panels and controls covered at all times while work is in progress.

! CAUTION !

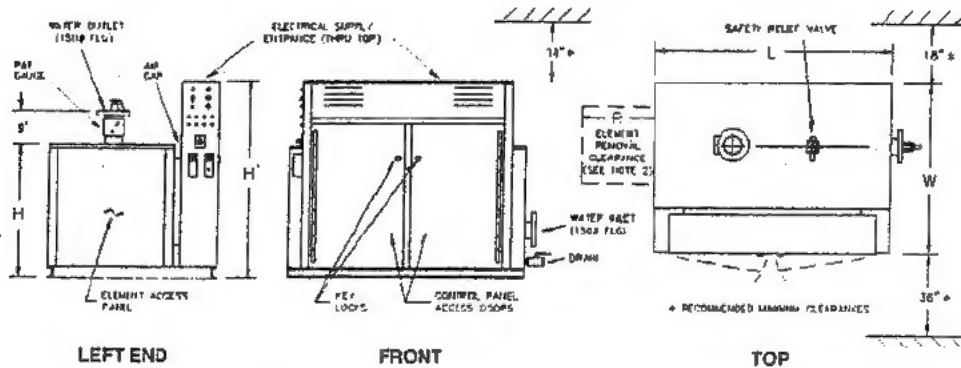
Do not use the boiler housing top for scaffolding.

Minimum Clearance Recommendations and General Dimensional Data for Boiler Placement

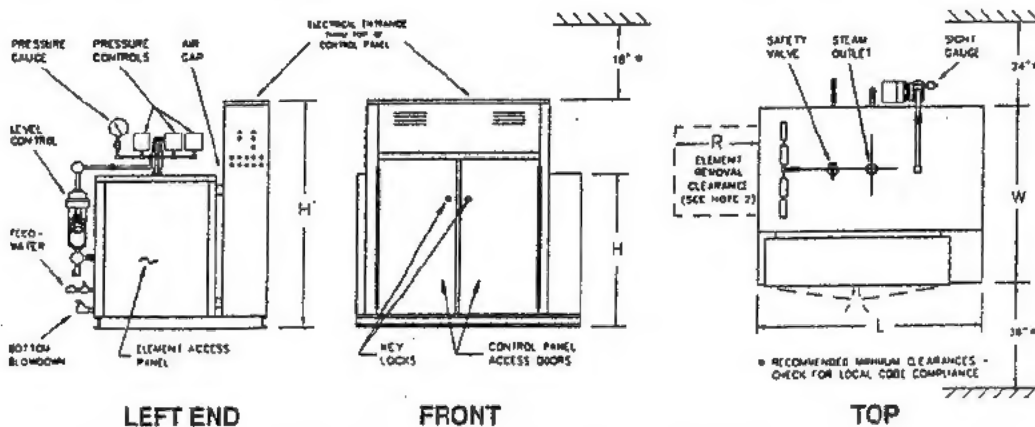
Compac



Electric Hot Water



Electric Steam Boiler



NOTE: Consult local codes for specific requirements and refer to the Dimensional Drawing (DD) and Wiring Diagram (WD) provided with the unit.

Chapter 3

INSTALLATION

3.A. PIPING CONNECTIONS

NOTE: Some of the following piping may have been completed at the Factory.

3.A.1. Boiler piping connections and valves **MUST** comply with state and local codes, in addition to compliance with ANSI piping requirements.

! CAUTION !

The pipe extensions outside the boiler are usually the extensions of pipes which are permanently welded into the boiler vessel. Normally the only removable (threaded) connection is the boiler drain pipe. **DO NOT ATTEMPT TO REMOVE ANY OTHER PIPING.**

3.A.2. Install the safety relief valve(s) on the pipes provided. Plumb the relief valve outlet connections full size to the floor drain. Check local codes for proper safety valve discharge for steam boilers above 15 psi which normally are required to be piped to overhead discharge outside safely away from personnel.

3.A.3. Hot water boilers may be equipped with an air vent pipe on the top of the boiler. Plumb this connection to the expansion tank or install an automatic air vent on this pipe.

3.A.4. The direction of flow through hot water boilers must be from the inlet to the outlet (ie, bottom to top). *Do not reverse these connections.*

NOTE: Do not oversize feedwater piping and valves on steam boilers, as this may result in severe pressure fluctuations during feedwater cycles if the fill rate is too rapid.

3.B. ELECTRICAL CONNECTIONS

3.B.1. Power Feed Wiring

The recommended wire size is listed on both the boiler Bill of Materials (BOM) and the Wiring Diagram (WD). Also, the full load amperage and maximum voltage are listed on both the Bill of Materials and the nameplate. Feed wires must be rated for the voltage and 125% of the full load amperage, according to Article 424-3 of the NEC. The wiring must be insulation-rated 75°C or greater. Copper wiring is recommended for all power connections.

! CAUTION !

Do not exceed the maximum voltage as listed on the nameplate.

3.B.2. Equipment Grounding Conductors

The boiler is equipped with grounding lug(s) inside the power panel(s). The grounding conductors must be installed and sized in accordance with NEC Article 424-14. The recommended size is noted in the Notes on the wiring diagram.

3.B.3. Control Wiring

Alteration of, or additions to, control wiring may void the Underwriters Laboratories Listing and the Manufacturer's Warranty. Field-installed controls, control connections, and modifications must be approved in writing by **LOCHINVAR**.

NOTE: All power connections to **LOCHINVAR** boiler(s) are 3-Phase, 3-Wire. (Exception: If boiler is single phase.) There is no provision for a neutral connection; ie, the boiler should not be wired "wye" or "star".

3.C. FILLING THE SYSTEM

3.C.1. The system and the boiler must be thoroughly flushed before the final fill. Steam boilers should be "boiled out" before operation.

3.C.2. Water Treatment

Consult a local water treatment firm for recommendations on proper water treatment and boilout procedure to prevent damage to the boiler vessel, components and heating elements.

The internal materials of the boiler are Steel, Incoloy and Cast Iron, which all are compatible with standard boilout compounds. In lieu of a commercial boilout compound, the following mix of chemicals can be used for every 1,000 gallons of water:

30 lbs tri-sodium phosphate (Na_3PO_4)
5 lbs caustic soda (NaOH)
2 lbs ordinary detergent

These chemicals should be dissolved in warm water prior to their addition to the boiler. The boiler should be heated for at least 3 hours, then drained and flushed.

NOTE: Standard hot water boilers are suitable for ethylene glycol mixtures up to a 50/50 mix.

Chapter 4

PRE-STARTUP INSPECTION

4.A. MINIMUM EQUIPMENT REQUIRED FOR STARTUP AND TROUBLESHOOTING

1. Volt-Ohm Meter
2. Clamp-On Ammeter
3. Megohm Meter
4. Torque Wrench - inch lbs
5. Torque Wrench - foot lbs

4.B. MECHANICAL SYSTEM CHECKS

4.B.1. Plumbing Connections Completed

- ☐ Inlet/ Makeup water?
- ☐ Discharge/Outlet?
- ☐ Drain/ Blowdown?
- ☐ Relief/ Safety Valve discharge?

4.B.2. Feedpumps/ Circulating Pumps

- ☐ Pumps wired, connected and checked for proper rotation?
- ☐ Is the boiler filled to the proper level with water?

4.B.3. System Flush

- ☐ Has the System been flushed?
- ☐ Has the unit been cleaned of all construction debris?

4.B.4. Valves

- ☐ Are all valves in the proper open or closed positions?

4.C. ELECTRICAL SYSTEM CHECKS

With boiler main power switch(es)
OFF and locked out:

- ☐ 4.C.1. Inspect all components, external and internal, to assure that there has been no damage during shipment or installation.

- ☐ 4.C.2. Remove one of the boiler control circuit transformer primary fuses. Then check the resistance phase-to-phase for all three phases. Make sure that there are no short circuits phase-to-phase or phase-to-ground.

With a megger (500VDC minimum) check contactor load side terminals to ground. If a reading of <1 megohm is obtained, consult the **LOCH INVAR** Agent or Factory.

Replace the control transformer fuse which was previously removed.

- ☐ 4.C.3. Remove element access panel(s) and open the doors to the electrical control panel(s). Run an inspection of the tightness of all electrical connections; (ie, at fuse lugs, power entrance lugs, contactors, heating elements).

Chapter 4

All branch circuit connections should be tightened to 35-40 inch lbs torque to avoid component damage from heat build-up.

This tightness inspection is vital, because the vibration during shipment can often loosen electrical connections. If this is not done, damage may occur to component parts when power is switched on, and those damaged parts will not be covered under the manufacturer's warranty.

- ☐ 4.C.4. With an ohmmeter, check the resistance between the phases on the load side of the contactors. Each should read the same and approximately what is shown on the wiring diagram.

- ☐ 4.C.5. Check the electrical panels for loose material, dust and/ or moisture. Thoroughly vacuum the panels if dust or foreign materials have accumulated there.

If there has been severe exposure to dust, the contactors should be disassembled and cleaned. Dust in the contactors will cause contactor chattering and eventual destruction of the contacts.

All components should be clean and free of dust, moisture, and foreign matter!

PRE-STARTUP INSPECTION

- ☐ 4.C.6. Verify that field-installed control and load connections have been properly installed.

4.D. HEATING ELEMENTS

! CAUTION !

Moisture in the elements may result in damage to the elements.

NOTE: There is a possibility that, during shipment or storage prior to operation, the elements may accumulate moisture. The moisture will turn to steam when the elements are turned on and may rupture the element casing.

4.D.1. How to check Elements for Moisture

Take a reading with a megger between the contactor terminals (load side) to ground for each contactor. Moisture is present if the reading is less than 1 megohm for standard 3-phase connection.

4.D.2. Removal of Moisture in Element

Method #1

Remove the fuses going to that contactor. The fuses should be removed so that, during the first day of operation, the affected element will not be energized allowing the hot boiler to drive the moisture out at a controlled rate.

4.D.3. Removal of Moisture in Element Method #2

An alternate heating method is to direct a heat lamp at the suspect element, or remove the element, bake it in a 200°F oven for 8 hours, then reinstall and rewire.

4.D.4. After completion of either of the above Methods for moisture removal, recheck the Element with a megger. When the reading indicates an acceptable level, the element may be put in operation by replacing the fuses.

4.D.5. Replace of Element Access Panel(s) and close electrical/ control panel doors.

4.E. INSPECTION POWER/ VOLTAGE

4.E.1. Verify the boiler ON/OFF control switch is in the "OFF" position. Close the boiler main power switch, switch the control switch to "ON" and then:

4.E.1.a. Check the phase-to-phase voltage at the main terminals in the boiler electrical panel. The phase-to-phase voltage between any two of the phases **must not exceed** the boiler nameplate voltage.

4.E.1.b. Check the voltage at the boiler control circuit fuse. It should be between 105 volts and 125 volts.

4.E.1.c. Open the boiler main power switch.

4.E.2. If all of the above prove satisfactory, proceed with "Startup Instructions". Replace all covers and close all doors.

Chapter 5

STARTUP INSTRUCTIONS

5.A. CONTROL SETTINGS

5.A.1. Controller

(See Parts List for Part No. and Type)

5.A.1.a. The controller is the pressure or temperature sensing device which controls the operation of the step control.

5.A.1.b. Set the Controller for the desired Outlet Water Temperature (or Steam Pressure).

NOTE: Outdoor reset (dual-bulb) controllers are set at the temperature at which the boiler should operate when the outdoor temperature is 70°F (this outdoor reference temperature is adjustable on most solid state controls; fixed on Honeywell T991B controllers). The reset ratio (fixed on Honeywell T991B type; adjustable on Honeywell T775J) is the number of degrees the boiler control temperature will increase for a 1 degree decrease in outdoor temperature.

5.A.1.c. Throttling Range - The throttling range is the number of degrees (or psi) the outlet water temperature (or steam pressure) must change to drive the step controller from full-off to full-on.

For instance, if the controller is set at 160°F, and the throttling range is set for 10°F, the step controller will be full-on at 155°F (1/2 of throttling range below setpoint) and full-off at 165°F (1/2 of throttling range above setpoint). The more stable the load on the boiler (from system demands), the smaller the throttling range may be set.

5.A.2. High Limit

(Temperature or Pressure)

Set the automatic reset high limit 10°F (or 5 psi), or twice the throttling range, whichever is greater, above the setting of the controller.

Manual reset limits should be set slightly higher than the automatic reset limits. For steam boilers, the manual reset high limit should be set at least 10% below the safety valve set pressure.

5.A.3. Low Water Cutoffs

These cutoffs are always factory-set. If additional cutoffs are field-installed, the cut-off levels should be at least three inches above the highest heating element. Manual reset cutoffs should be set below automatic reset cutoffs.

5.A.4. Low Limit Sensors (Temperature or Pressure)

Low limits should be set below the controller setting by at least the same margin as specified for high limits to be above the controller setting.

5B. OPERATING INSTRUCTIONS

5.B.1. With the boiler main power ON/OFF or ON/OFF/PREHEAT switch "OFF", close the boiler main power switch. Close the boiler disconnect switch, if provided.

NOTE: Boilers with shunt trip disconnects and remote 120-volt control power may require turning the boiler control power switch "ON" and activating the 120-volt power before closing the boiler main power switch(es).

5.B.2. Electric Door Interlocks

For boilers equipped with electric door interlocks, do not attempt to open electrical panel doors after the main switch is closed. The lock tabs are mechanically restrained by the electric interlocks.

5.B.3. 120-Volt Power Source

If a separate 120-volt power source is provided, close its disconnect switch.

5.B.4. Turn the boiler main power ON/OFF or ON/OFF/PREHEAT switch to "ON".

5.B.5. Alarm and Reset Circuits

5.B.5.a. If the alarm sounds when the control switch is turned "ON", depress

the alarm silence button. Check the boiler to make certain that no limit conditions exist by noting if the alarm pilot light is illuminated. The alarm will sound momentarily on some boilers when power is initially applied.

5.B.5.b. Boilers with Manual Reset Button(s) may require resetting of the manual reset switch upon initial application of power, and after the interruption of power or the trip-out of a limit control.

5.B.6. Sequencing of Element Circuits

5.B.6.a. On boilers with step controls, the boiler will always start with no steps energized.

5.B.6.b. As the steps begin cycling on, the pilot lights will light up one at a time, indicating that power has been applied to the associated contactor coils.

5.B.6.c. For electric boilers with ON/OFF/PREHEAT switches, when the switch is down in the "PREHEAT" position, only part (approximately 25%) of the steps may be activated.

5.B.6.d. When the boiler outlet water temperature (or steam pressure) is at or near setpoint, turn the boiler ON/OFF/PREHEAT switch "OFF", then to "ON" again. The controls will recycle to the no-load condition. The steps should then begin to cycle on as needed, and all of the steps may come on if necessary.

Chapter 6

SEQUENCE OF OPERATION

6.A. ACTIVATION OF HEATING ELEMENT CIRCUITS

6.A.1. Contactors

The heating elements are energized by pilot operation. That is, the power to an element circuit is supplied through the contacts of a contactor. The contactor is activated (on a call for heat) by the closure of a temperature (or pressure) switch or by a contact in the step control circuit.

6.A.2. Fuses

All power leads to the elements are fused. The fusing is on the line side of the contactors.

6.B. SEQUENCING CONTROLS

6.B.1. Staged Control Circuit

6.B.1.a. In this type of circuit, the contactor coils are energized directly by the contacts of immersion thermostats (or pressuretrols). There is usually one thermostat (or pressuretrol) for each stage; or a multi-stage thermostat (or pressuretrol) may be provided in some cases.

6.B.1.b. The safety limit devices (high temperature, low water, etc) interrupt the power to the contactor coil circuits.

6.B.2. Proportional Step Controls

6.B.2.a. Step Control Sequence

The controller senses the boiler water temperature (either via 135-ohm device or thermistor) or the boiler steam pressure (either via 135-ohm device or 4-20ma transducer). The output signal of the controller causes the step control to sequence the steps on, or off, depending on whether the boiler output is below or above setpoint.

When one of the switches closes on the step control, a contactor coil (or coils) is energized in a step-wise fashion. This type of step control will mid-position (bring on half of the steps) when the boiler water temperature (or steam pressure) is at setpoint.

For example: an 8 step steam boiler with the pressure controller set at 12 PSIG, will have 4 steps on when the boiler steam pressure is at 12 PSIG.

6.B.2.b. Progressive Sequence Step Controls

These controls are provided as standard and include Selectronix SLC series, Solitech M72 series, and Honeywell W7100J series. They provide first-on, first-off staging of the element circuits.

Chapter 6

SEQUENCE OF OPERATION

As the boiler temperature (or pressure) drops below setpoint, the control brings on more steps. As the temperature (or pressure) increases and approaches setpoint, the step control drops out stages. The first step to drop off is the one that has been on the longest. This provides even usage of the system's components.

6.B.2.c. Linear Sequence Step Controls

This type of step control is limited to the Solitech M72. In this sequence progression, the control applies power by progressing from Step 1 to the maximum number required to satisfy the load, and then decreases power by retracing this sequence down toward the first step.

NOTE: Refer to the applicable vendor literature provided on the step control installed in your boiler.

6.B.3. Recycle Feature

All step controls now incorporate the recycle feature which returns the step control to the no-load condition upon loss of control power.

6.B.4. Preheat Switch

The preheat switch is a manual limit switch. In order to preheat the boiler, the ON/OFF/PREHEAT switch must be in the down position. When the ON/OFF/PREHEAT switch is in its down or PREHEAT position, the boiler output is limited to approximately 25% of full load power. This allows the operator to limit the boiler output during startup cycles (particularly if the boiler is shut off at night and turned on again in the morning), which could lessen electrical demand charges.

When the boiler has been brought up to the setpoint temperature (or pressure), the ON/OFF/PREHEAT switch is moved slowly from its down or PREHEAT position to its up or ON position passing through the OFF position to cause the control to recycle to the NO-LOAD position. Thereafter, the boiler can operate up to full load if necessary.

NOTE: The PREHEAT switch is included as standard equipment on boilers of 9 or more steps. It is intended to be used to prevent setting demand peaks on "cold starts". It does not have to be used if so desired.

Chapter 7

OPERATIONAL TESTING

7.A. STANDARD CONTROLS

7.A.1. 135-ohm Controllers (T991, T915, L91, etc)

With the boiler water temperature (or steam pressure) at setpoint, the step controller should bring on nominally one half of the steps. An adjustable proportional band is provided on the controller (sensor) to enable tuning the boiler to system demand.

7.A.2. Solid State Controls

With the boiler water temperature (or pressure) at setpoint, the step control should bring on nominally one half of the steps. Adjustable time delays between steps and adjustable proportional bands are normally provided on the step control to enable tuning the boiler to system demand. Most solid state controls also include band width adjustment at the control itself, and normally include PID control action.

7.B. OUTDOOR RESET CONTROLS

7.B.1. 135-ohm Type Outdoor Reset Controller (Honeywell T991B type)

These controllers have a fixed reset ratio: either 1-to-1, 1-to-1.5 or 1.5-to-1.

The outdoor reference temperature is 70°F; ie, the boiler outlet water control point temperature is equal to the setting on the controller when the outdoor temperature (at the outdoor bulb) is 70°F. In order to test the operation of this controller:

7.B.1.a. Check the outdoor temperature at the outdoor air sensing bulb; then determine the number of degrees this temperature is above, or below, 70°F.

7.B.1.b. Check the boiler outlet water temperature; if the outdoor temperature is below 70°F, multiply the difference between 70°F and the actual outdoor temperature by the reset ratio (1, 0.67 or 1.5); and subtract this from the temperature of the boiler outlet water.

7.B.1.c. Then set the controller at this resultant temperature; the step controller should maintain nominally half of the steps on.

NOTE: If the outdoor bulb is at 70°F, or can be maintained at 70°F, simply set the controller at a temperature equal to the actual outlet water temperature to perform this test.

EXAMPLE: SETTING THE TEMPERATURE CONTROLLER

Reset Ratio: 1:1-1/2 (ie, 2/3:1)

Outdoor Temperature: 40°F

Boiler Water Temperature: 130°F

STEP "A"	Difference between outdoor temp and 70°F	$70 - 40 = 30^{\circ}\text{F}$
STEP "B"	Multiply 30°F times the Reset Ratio 2/3	$30 \times 2/3 = 20^{\circ}\text{F}$
	Subtract 20°F from the Boiler Water Temp 130°F	$130 - 20 = 110^{\circ}\text{F}$
STEP "C"	Set the Controller at 110°F	

NOTE: If the Outdoor Temperature is above 70°F, add the difference in STEP "A", multiplied by the Reset Ratio, to the Boiler Water Temperature.

7.B.2. Solid State Dual Input**Reset Controls**

(Honeywell T775J controls and Honeywell W7100J Sequencers)

These are dual sensor reset controllers with adjustable reset ratio and outdoor reference temperature. The "reset ratio" is the ratio of the change in the temperature at the secondary sensor to the opposing change in the control point. If the reset ratio is 2:1, then every 2°F change at the outdoor sensor will cause an automatic inverse change of 1°F at the control point.

Example:

Assume a reset ratio of 2:1, a primary set point of 100°F, and a secondary setpoint at 70°F. The first number of the reset ratio indicates change in outdoor temperature; the second, the change in the control point. If the outdoor temperature drops from 70°F to 20°F, a change of 50°F; the control point will increase from 100°F to 125°F, a change of 25°F.

NOTE: Refer to the applicable vendor literature provided on both the setpoint controls and step controls installed in your boiler.

Chapter 8

PREVENTIVE MAINTENANCE

8.A. GENERAL

Electric immersion heating element boilers are automatic, quiet and safe. Consequently, they are all too often neglected. Like any piece of electrical mechanical equipment, they require care and maintenance to keep them in top working condition.

If electrical connections are allowed to become loose or dirty, there is danger of an electrical fault. If the elements are not inspected periodically for leaks, the water from leaking elements can leak onto adjacent elements, causing external element damage and resulting in the blowing of load fuses in the boiler electrical panels. If the boiler water is not properly treated, element failure could occur due to the formation of scale.

Treat the boiler with respect.

! CAUTION !

Always work on the boiler with all electrical power sources disconnected.

8.B. WATER TREATMENT

Boiler water should be periodically checked through a sampling procedure. Properties should be maintained in accord with *TABLE 8.1* at the end of this chapter. For consultation relative to water treatment, please contact a reputable water treatment firm.

8.C. BOILER ELECTRICAL SYSTEM MAINTENANCE

8.C.1. Clean the boiler periodically (as often as needed) to keep both the interior and the exterior free of dust, moisture and foreign matter. The interior cleaning of the electrical panels must be done with the **POWER OFF!!**

NOTE: For units supplied with control cabinet cooling fans, the condition of the fan filter must be periodically checked and the filters cleaned or replaced as necessary.

8.C.2. With the **POWER OFF**, periodically check the tightness of electrical connections; particularly at power entrance lugs, fuses (line side) and contactors (load side).

Chapter 8

- 8.C.3. Inspect the condition of the contactors. Look for burned or corroded contacts or overheated coils and wires. If the contactors chatter or hum during operation, they should be disassembled and cleaned to remove dust or other foreign material in the works or replaced if needed.
- 8.C.4. Inspect the heating elements. Make sure that the terminal contacts are tight, clean, and corrosion-free.
- 8.C.5. Check all the wiring throughout the boiler for frayed or brittle insulation. Replace any wiring having exposed metal parts.

8.D. BOILER MECHANICAL SYSTEM MAINTENANCE

- 8.D.1. With the POWER OFF, remove the element access covers. Inspect all internal plumbing connections, particularly at the heating elements. Spot check torque on element flange bolts. The acceptable torque range is 10-15 ft lbs.

! CAUTION !

DO NOT OVERTIGHTEN
ELEMENTS

- 8.D.2. Remove and replace any leaking elements or element gaskets. Inspect handhole and manhole gaskets. If these gaskets are brittle they should be replaced.

! WARNING !

Over-torqueing of the element nuts will damage the element gasket.

PREVENTIVE MAINTENANCE

- 8.D.3. Repair any leak at any place on the boiler or adjacent piping.
- 8.D.4. The interior of the pressure vessel must be inspected at least once a year. If there is any presence of scale, refer to Preventive Maintenance Water Treatment above and consult a local water treatment firm immediately. Scale formation on the elements will cause heating element failures. Scale formation elsewhere in the boiler can cause erratic control operation, particularly on water level controls.
- 8.D.5. When the boiler is inspected, rod out the pipes to the water column(s). Inspect the operation of the floats in the level controller(s).
- 8.D.6. Remove and clean the low water cutoff probe.
- 8.D.7. Steam Boiler Special Maintenance
- 8.D.7.a. All **LOCHINVAR** steam boilers are supplied with a surface blow-off connection. If surface blow-off valves are not Factory-installed, they should be installed in the field. The surface blow-off should be used as often as necessary to remove organics which accumulate at the water surface, and to limit TDS. (Boiler water TDS should not exceed 3500 PPM).
- 8.D.7.b. Both the boiler and water column should be blown down periodically to remove bottom sludge.
- 8.D.7.c. The water column should be blown down daily to assure proper operation of the level control/LWCO assembly.

Chapter 8

PREVENTIVE MAINTENANCE

8.D.7.d. Water Treatment

Water treatment is required for satisfactory operation of steam boilers to prevent both deposition of scale and corrosion from acids, oxygen and other harmful elements that may be in the water supply. A qualified water treatment specialist should be consulted to establish a proper water treatment program.

8.E. ELEMENT REPLACEMENT PROCEDURE (4-Bolt Style Element)

NOTE: To prevent hazardous conditions of leaking water/ steam at the element terminal ends, defective elements or element gaskets should be replaced immediately upon leak detection.

8.E.1. Adequately tag wires and then remove wires from defective elements.

8.E.2. Remove element by removing the 4 (four) attachment nuts.

8.E.3. Install replacement element with new gasket and torque nuts to 10 - 15 ft lbs.

! CAUTION !

Before element replacement, make certain main power to boiler is turned off, that there is no pressure in the boiler, and that boiler is drained below element opening.

! WARNING !

Do not exceed 15 ft lbs.

8.E.4. Connect phase wires to new element.

8.E.5. When boiler is filled and pressurized, check for leaks.

TABLE 8.1

Recommended Feedwater and Boiler Water Properties

FEEDWATER

Type of Boiler	Hardness (ppm)	pH	Oxygen (cc/ l)	Total Dissolved Solids TDS (ppm)
Hot Water	0-10	7.5 - 9.5	4.0	0-500
Steam	0-5	7.5 - 9	.03	0-350

BOILER WATER

Type of Boiler	Hardness (ppm)	pH	Oxygen (cc/ l)	Total Dissolved Solids TDS (ppm)
Hot Water	0-10	7.5 - 9.5#	0	0-5000
Steam	0	7.5 - 9.5#	0	0-3500

The limit of 9.5 pertains to copper elements; a pH of 10.5 is allowable for Incoloy elements

Chapter 9

WARRANTY & RETURNS

9.A. ASSISTANCE

Furnish Complete Information

Before calling the **LOCHINVAR** Agent or the Factory with questions concerning boiler operation, needed parts, or warranty, please be sure to have the information readily available that is stamped on your Boiler's Data Plate (see Data Plate details below *FIGURE 9.1*).

All files are maintained by Serial Number, so please have this number available when corresponding about your boiler. All order(s) should state the Manufacturer's part number, if known, and the name and description of the part required. Also, state the quantity desired and specify the method of shipment.

9.B. PART ORDERS

Repair or replacement parts for **LOCHINVAR** boilers may be ordered through the **LOCHINVAR** Agent in your area. You may also contact the Factory directly at the address or phone number listed on the back of this manual. Refer all inquiries directly to the Parts Department.

9.C. REPAIR PROCEDURES

Parts to be repaired should be returned freight prepaid to the address indicated on the back of this Manual. Please indicate the urgency of the repair.

FIGURE 9.1

		ASME	
MODEL		NAT'L. BD.	
SERIAL			
K.W.		MAX. W. P.	P.S.I.
		M.S.V.R. CAP.	
VOLTAGE	PHASE	B.T.U./HR	
AMPERES		LB/HR	
STEPS OF	K.W.	DATE	
STEPS OF	K.W.		

Chapter 9

WARRANTY & RETURNS

9.C. WARRANTY RETURN PROCEDURES

A purchase/ service order, or a letter authorizing repairs, showing Model Number and Serial Number of the Boiler, and giving complete details, should be mailed to the address listed on the back of this manual. Please include inside the package a packing slip identifying the parts with your company's name. Return shipment must be freight prepaid. Freight collect shipments will not be accepted.

9.D. PRECISION LIMITED WARRANTY

The Limited Warranty was shipped with the Boiler and thoroughly identifies the period, items covered, and terms of the Limited Warranty

Parts being returned for replacement or repair covered

under the warranty as defective must be identified and accompanied by a Return Goods Authorization (RGA). RGA's are available from the Factory Service Department.

When defective goods are returned with the appropriate information, either a replacement or repair part will be provided under the conditions of the Limited Warranty. If a replacement part has been purchased from the Factory, these goods will be invoiced and shipped under standard sales terms. Once the defective goods are returned within the authorized 30 day time period, and the Factory verifies that the material and/ or workmanship is defective, then appropriate credit will be issued for the part or a repair will be made. Return shipments must be freight prepaid. Freight collect shipments will not be accepted.
